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(54) **Enzyme-containing granulated product, method of preparation, and compositions containing the granulated product**

Enzym enthaltendes Granulat, Herstellungsmethode und das Granulat enthaltende Zusammensetzungen

Produit granulé contenant une enzyme, méthodes pour sa préparation et compositions contenant le granulat

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EP 0 780 466 B1

Description

[0001] The present invention relates to an enzyme-containing granulated product having improved stability, and more particularly to an enzyme-containing granulated product that undergoes only minimal reduction in activity even in the presence of peroxides typified by bleaching agents. The invention also relates to methods for preparing such products as well as to bleach compositions and detergent compositions containing the product.

[0002] Detergents and bleaches for clothing frequently contain a variety of enzymes, in addition to surfactants or bleaching ingredients, in an effort to improve detergent power. These enzymes are usually incorporated in the form of granules so as not to lose their activity during storage and to sufficiently exhibit their activities during washing. The enzymatic stability of such enzyme-containing granulated products decreases when the granulated products are blended with bleaching agents, surfactants, builders for detergents, or similar materials. In particular, it is known that enzyme activity decreases considerably when a granulated product is blended with a bleaching agent.

[0003] Measures to prevent the reduction of enzyme activity of enzyme-containing granulated products are disclosed by Japanese Patent Application Laid-Open (*kokai*) No. 62-79298, which describes an enzyme composition in which the core part containing an enzyme is coated with a protective layer containing an alkaline buffering salt of pH 7-11, and by Japanese Patent Application Laid-Open (*kokai*) No. 3-149298, which describes a bleaching agent containing hydrase particles, in which the enzyme nuclei are coated with a protective agent such as a water-soluble alkali metal silicate, a transition metal, or a reducing agent.

[0004] However, those conventional methods for stabilizing enzymes have a problem in that when the thickness of the coating layer is increased or a large amount of a water-soluble substance is incorporated into the coatings so as to fully stabilize the enzymes, the enzyme-containing granulated products come to have reduced solubility in water, and therefore the detergent power of enzymes cannot be sufficiently exerted during use in washing. On the other hand, when the thickness of the coating layer is reduced for the purpose of solubility, the enzymes cannot be satisfactorily stabilized.

[0005] Under the above circumstances, the present inventors conducted a variety of studies regarding means for stabilizing enzymes, and found that, as far as enzymes, such as hydrolase, are concerned, the copresence, in a uniformly dispersed state, of such an enzyme, and a stabilizing agent, such as a reducing agent or an antioxidant, is effective in avoiding deactivation of the enzyme and provides a granulated product having excellent solubility. This is surprising because in the past, it has been customary in the preparation of such a granulated product to separate an enzyme from a reducing agent by the use of a coating. The present invention was accomplished based on this finding.

[0006] EP-A-0 206 418 discloses a method for stabilizing enzymes without using the coating procedure. In particular, EP-A-0 206 418 refers to a storage stable granular composition comprising a homogeneously mixed granulate of enzymes and alkaline buffer salt to protect enzymes from deactivation when mixed with a strong peroxyacid bleach granulate. Also a method for preparing said composition is disclosed whereby the constituents are granulated as wet powder mixtures and subsequently dried.

[0007] Accordingly, the present invention provides an enzyme-containing granulated product comprising an enzyme and two or more stabilizers characterized in that the stabilizers are a combination of a reducing agent and an antioxidant; and a method for preparing such a product.

[0008] The present invention also provides a bleach composition comprising the enzyme-containing granulated product and a bleaching agent.

[0009] The present invention also provides a detergent composition comprising the enzyme-containing granulated product and a surfactant.

[0010] The enzyme-containing granulated product of the present invention comprises, in a uniformly dispersed state, an enzyme, and two or more stabilizers which are a combination of reducing agents and antioxidants. As used herein, the expression "in a uniformly dispersed state" refers to a state in which an enzyme and stabilizer are not segregated in separate layers, and therefore, an enzyme and a stabilizer are not necessarily in a dispersed state on the molecular level and they may be present as a dispersed powder.

[0011] Enzymes which are used in the present invention are not particularly limited as long as they can be incorporated into bleaching agents or detergents. Preferably, hydrolases are used, and specifically, proteases, esterases, and carbohydrases are used.

[0012] Specific examples of proteases include pepsin, trypsin, chymotrypsin, collagenase, keratinase, elastase, subtilisin, papain, aminopeptidase, and carboxypeptidase.

[0013] Specific examples of esterases include gastric lipase, pancreatic lipase, lipases of vegetable origin, phospholipases, choline esterases, and phosphatases.

[0014] Specific examples of carbohydrases include cellulase, maltase, saccharase, amylase, pectitase, and α- and β-glycosidases.

[0015] The stabilizer used in the present invention is a mixture of two or more of reducing agents and antioxidants.

[0016] Examples of reducing agents include alkali metal salts (such as sodium salts and potassium salts) and alkaline

earth metal salts (such as calcium salts and magnesium salts) of boric acid, sulfurous acid, thiosulfuric acid. Specifically, sodium tetraborate, sodium sulfite, and sodium thiosulfate are used. Specific examples of antioxidants include ascorbic acid, sodium ascorbate, erythorbic acid, sodium erythorbate, dl-α-tocopherol, isopropyl citrate, butylated hydroxytoluene (BHT), butylated hydroxyanisol (BHA), tannic acid, and sulfur-containing antioxidants. Of these, sodium tetraborate, sodium erythorbate, and mixtures thereof are particularly preferred.

[0017] The enzymes and stabilizers may be used singly or in combinations of two or more. The amount of enzymes contained in the granulated product is not particularly limited. In consideration of the effect desired when the enzymes are incorporated into detergents or bleaching agents, it is generally preferred that the amount of the enzymes is between 0.01 and 50% by weight, and more preferably between 0.1 and 30% by weight. The amount of stabilizers varies depending on the types of enzymes employed. It is preferred that the stabilizers are incorporated at a concentration between 0.1 and 3,000% by weight, more preferably between 1 and 500% by weight, and particularly preferably between 10 and 300% by weight, calculated in relation to the amounts of enzyme protein. The ratio (by weight) of the reducing agent to the antioxidant which are to be incorporated is between 1/9 and 9/1, preferably between 1/3 and 3/1, and particularly preferably between 1/3 and 1/1.

[0018] The granulated product of the present invention may contain further additives, in addition to the above-mentioned components, which are needed for granulation. Such additives include binders, particularly water-soluble organic binders. The following may be cited as examples of water-soluble organic binders that can be used together with the mentioned essential components of the present invention: (a) water-soluble polymers selected from the group consisting of polyethylene glycol having a melting point of not lower than 35°C, derivatives thereof, and polyoxyethylene polyoxypropylene copolymers; (b) nonionic surfactants having a melting point or pour point of not lower than 35°C; and (c) polycarboxylates having a mean molecular weight of not less than 4,000. These may be used singly, or in combinations of two or more.

[0019] Specific examples of particularly preferred water-soluble organic binders include, among the class of polyethylene glycol and its derivatives (a), polyethylene glycol, polyethylene glycol sulfate, and methoxypolyethylene glycol; among the class of nonionic surfactants (b), polyoxyethylene alkyl ethers; and among the class of polycarboxylates (c), alkali metal salts of polyacrylic acid, acrylic acid/maleic acid copolymers, and polyacetal carboxylate.

[0020] These water-soluble organic binders are advantageous, since they are components which are also used in detergent compositions. The amount of usually employed water-soluble organic binders is not univocally determined, as their properties vary from binder to binder. However, under general circumstances, those which exhibit binding power at a minimum concentration are usually preferred as they provide room for maximizing the enzyme activity of the resultant enzyme-containing granulated products. From this point, these water-soluble organic binders are usually incorporated in an enzyme-containing granulated product at a concentration of 5 to 50% by weight, and preferably 10 to 30% by weight.

[0021] According to the present invention, powdery bulking agents may also be added if needed. Exemplary bulking agents include one or more inorganic salts selected from the group consisting of sulfates, carbonates, and hydrochlorides of alkali metals or alkaline earth metals. Of these, water-soluble inorganic alkali metal salts such as sodium sulfate, sodium carbonate, and sodium chloride are particularly preferred in view that they do not adversely affect detergent power. Other useful bulking agents include water-soluble organic salts such as sodium citrate, talc, titanium oxide, calcium carbonate, zeolite, magnesium carbonate, activated clay, and kaolin.

[0022] The granulated product of the present invention may also contain a variety of inorganic salts such as calcium salts and magnesium salts; as well as organic materials including surfactants, saccharides, and carboxymethylcellulose. Moreover, if synthesized hectorite or sepiolite is incorporated, odoriferous components derived from cultivation can be adsorbed. The enzyme-containing granules may be colored by incorporating thereto colorants or dyes.

[0023] The method for the manufacture of the granulated product of the present invention is not particularly limited so long as it is capable of incorporating an enzyme and a stabilizer in a uniformly dispersed state. For example, any of the following methods may be used: (1) a solution containing an enzyme and a stabilizer is dried, followed by granulation; (2) a solution containing an enzyme and a stabilizer is subjected to a wet granulation process and subsequently the granulated material is dried; and (3) an enzyme powder and a stabilizer powder are uniformly blended, followed by granulation. Of these, method (1) is particularly preferred.

[0024] In method (1) above, the solution containing an enzyme and a stabilizer is preferably an aqueous solution, and more preferably an aqueous solution containing a buffer agent. The solution may be dried via spray-drying, or freeze-drying, with spray-drying being particularly preferred. Means for granulating the resultant dry powder are not particularly limited, and wet granulation and dry granulation are both preferable. Illustrative granulation methods include extruding, tumbling, fluidized-bed granulation, spray granulation, and disintegration granulation. Among them, tumbling granulation, particularly tumbling granulation with agitating blades, is preferred. Examples of mixing tumbling granulation machines are a Henschel mixer (Mitsui-Miike Kakoki K.K.), a high-speed mixer (Fukae Kogyo K.K.), and a vertical granulator (Fuji Sangyo K.K.). These three share a common feature of having a vertical agitator axis with a mixing blade inside a mixing tank of a vertical type. A granulator having a horizontal agitator axis, a Loedige mixer (Loedige

Co.), may also be used.

[0025] When method (2) is used, a solution containing an enzyme and a stabilizer can be prepared in a manner similar to that of method (1).

[0026] In method (3), dry-format granulation is performed.

[0027] The particle size of the thus-obtained granulated product is not particularly limited. The mean particle size is generally between 200 and 3,000 μm, and preferably between 350 and 1,500 μm.

[0028] The enzyme-containing granulated product of the present invention preferably has a coating thereon so as to obtain even further improved stability, though the product may be used without coating.

[0029] Materials used for coating the enzyme-containing granulated product of the present invention are not particularly limited. They may be water-soluble film-forming polymers such as polyethylene glycol, polyacrylate, polyvinyl alcohol, polyvinyl pyrrolidone, cellulose derivatives, and starch derivatives; combinations of these polymers and water-soluble or slightly-soluble inorganic particles such as talc, clay, titanium oxide, calcium carbonate; or combinations of the polymers and protective agents such as alkali metal silicate and alkali metal carbonates.

[0030] Coating materials are preferably used in a ratio by weight of 0.1 to 0.7, particularly preferably 0.2 to 0.6, when the amount of the enzyme-containing granulated product is taken as 1.

[0031] The enzyme-containing granulated product of the present invention may be coated through a conventional method using a fluidized bed granulator, a granulator equipped with a coating pan, or a mixing granulator.

[0032] Since the granulated product of the present invention is very stable against a variety of peroxides which are used as bleaching agents, when the granulated product and a bleaching agent are blended it is possible to obtain a bleaching agent exhibiting stable enzyme activity and providing an excellent bleaching effect. Examples of useful bleaching agents include sodium percarbonate, sodium perborate, sodium hypochlorite, and dichloroisocyanic acid. They are usually incorporated in bleaching compositions at a concentration of 10 to 95%, and preferably 50 to 80%.

[0033] The granulated product of the present invention maintains excellent enzyme stability even when it is formed into a detergent composition containing a bleaching agent and a surfactant. Bleaching agents which are useful in this case are the same as those listed above. The amount of bleaching agents is 0.5-45% by weight, and particularly preferably 1-20% by weight.

[0034] The amount of the enzyme-containing granulated product to be incorporated into a detergent composition varies depending on the specific activity in the enzyme powder, type of the enzyme, and the content of the enzyme in the granulated product. It is preferably between 0.001 and 70% by weight, and particularly between 0.1 and 10% by weight.

[0035] The following may be mentioned as examples of surfactants which are used in the present invention: anionic surfactants, e.g., alkylbenzene sulfonates, alkyl or alkenyl ether sulfates, alkyl or alkenyl sulfates, olefin sulfonates, alkane sulfonates, saturated or unsaturated fatty acid salts, alkyl or alkenyl ether carboxylates, α-sulfofatty acid salts or esters, amino acid-type surfactants, N-acylamino acid-type surfactants, alkyl or alkenyl acid phosphates, alkyl or alkenyl phosphates, and their salts; amphoteric surfactants, e.g., carboxy or sulfobetaine-type surfactants; nonionic surfactants, e.g., polyoxyalkylene alkyl or alkenyl ethers, polyoxyethylene alkylphenyl ethers, higher fatty acid alkanolamides and their alkylene oxide adducts, sucrose fatty acid esters, fatty acid glycerol monoesters, alkyl amine oxides, and alkyl glycosides; and cationic surfactants, e.g., quaternary ammonium salts. These surfactants are preferably incorporated in the detergent composition of the present invention at a concentration of 10-90% by weight, and particularly preferably 10-50% by weight.

[0036] Preferably, the detergent composition of the present invention contains inorganic electrolytes and chelating agents. Examples of inorganic electrolytes include carbonates, hydrogen carbonates, silicates, borates, and alkanolamines and sulfates. They are usually incorporated in amounts between 0 and 90% by weight, and preferably between 1 and 40% by weight.

[0037] Examples of chelating agents include phosphates such as tripolyphosphates, pyrophosphates, and orthophosphates; salts of phosphonic acid such as ethane-1,1-diphosphonic acid; salts of phosphonocarboxylic acid such as 2-phosphonobutane-1,2-dicarboxylic acid; salts of amino acids such as aspartic acid and glutamic acid; aminopolyacetates such as nitrilotriacetate and ethylenediaminetetraacetate; polymer chelating agents such as polyacrylic acid and polyaconitic acid; salts of organic acids such as oxalic acid and citric acids; and aluminosilicates. These chelating agents are usually incorporated in a detergent composition at a concentration of between 0 and 50% by weight, with between 1 and 30% by weight being more preferred.

[0038] Optional ingredients may be incorporated as desired in small amounts. Such optional ingredients include antiredeposition agents, e.g., polyethylene glycol and carboxymethylcellulose; fluorescent dyes; bluing agents; colorants; caking preventive agents; solubilizers; enzymes or activators for bleaching agents; and metal corrosion inhibitors.

[0039] The detergent composition of the present invention can be prepared by blending the above-mentioned ingredients to thereby form a granular detergent composition for clothing, dishes, and for house cleaning, according to conventional methods.

Examples

[0040] The present invention is further illustrated by the following Examples, which should not construed as limiting the invention.

Example 1:

[0041]

(1) An aqueous solution containing a crude enzyme having an amylase activity (derived from *Bacillus* sp. KSM-AP1378 (FERM BP-3048) was used as an aqueous enzyme solution (concentration of enzyme protein: 0.3% by weight). To this solution, sodium tetraborate (indicated as A in Table 1) and sodium erythorbate (indicated as B in Table 1) were added as stabilizers so that the amount of the stabilizers became 1-10 times that of the mass of the enzyme protein in the aqueous solution (on a weight basis). The thus-prepared mixtures were used as samples.
(2) A control sample (which did not contain a stabilizer) and the sample prepared in (1) were spray-dried by the application of 150°C air produced by an atomizer-type spray drier (temperature of exhaust air: 75°C), thereby obtaining a solid granular enzyme preparation.
(3) The stability of the enzyme in a bleaching agent was assessed by measuring the percentage residual activity after storage at 40°C and a relative humidity of 80% for 3 days. As a model bleaching agent, a composition including 85% by weight of sodium percarbonate, 3% by weight of linear alkyl(C_{12}-C_{13})benzenesulfonate, and 12% by weight of sodium carbonate was used. This bleaching composition was blended with the solid granular enzyme preparation at a ratio of 5:1 (by weight) and the resultant mixture was stored under the above-mentioned conditions. The results are shown in Table 1.

Table 1

Samples (stabilizer, enzyme protein : stabilizer (ratio by weight))	Residual activity(%)
Control	5
Sample 1 (A, 1 : 1.5)*	10
Sample 2 (A, 1 : 5)*	25
Sample 3 (A, 1 : 10)*	30
Sample 4 (B, 1 : 2.5)*	20
Sample 5 (B, 1 : 5)*	25
Sample 6 (A, 1 : 5 B, 1 : 2.5)	57
Sample 7 (A, 1 : 10 B, 1 : 2.5)	74

* Not in accordance with the invention.

Example 2:

[0042] An enzyme-containing granulated product prepared in Example 1 and, for comparison, a granulated product coated by the addition of a stabilizer during the step of granulation were incorporated into a bleaching agent. The general procedure of Example 1 was repeated, and the stability of the enzyme was assessed by measuring the percentage residual activity after storage at 40°C and a relative humidity of 80% for 5 days. The results are shown in Table 2. In Table 2, Comparative Sample 1 was prepared by coating a granulated product which was identical to the control product using a stabilizer in the amount same as that employed in the preparation of Sample 7. Sample 7 was the same as that used in Example 1.

Table 2

Samples	Residual activity (%)
Control (without a stabilizer)	5
Comparative Sample 1 (coated with a stabilizer)	6
Sample 7 (same as that used in Example 1)	80

Example 3:

[0043] An aqueous solution of a crude enzyme having cellulase activity (derived from *Bacillus* sp. KSM635-KNV (FERM P-13549)) was used as an aqueous enzyme solution (concentration of enzyme protein: 2.5% by weight). To this solution, sodium tetraborate (indicated as A in Table 3) and sodium erythorbate (indicated as B in Table 3) were added as stabilizers so that the amount of the stabilizers became 1-2 times that of the mass of the enzyme protein in the aqueous solution (on a weight basis). The thus-prepared mixtures were used as samples. Subsequently, a similar procedure as described in Example 1 was performed.

Table 3

Samples (stabilizer, enzyme protein : stabilizer (ratio by weight))	Residual activity(%)
Control	16
Sample 8 (A, 1 : 1 B, 1 : 1)	91
Sample 9 (A, 1 : 2 B, 1 : 2)	98

Example 4:

[0044] An aqueous solution of a crude enzyme having protease activity (derived from *Bacillus* sp. KSM-K16 (FERM P-3367)) was used as an aqueous enzyme solution (concentration of enzyme protein: 7.5% by weight). To this solution, sodium tetraborate (indicated as A in Table 4) and sodium erythorbate (indicated as B in Table 4) were added as stabilizers so that the amount of the stabilizers became 0.25 to 0.5 times that of the mass of the enzyme protein in the aqueous solution (on a weight basis). The thus-prepared mixtures were used as samples. Subsequently, a similar procedure as described in Example 1 was performed.

Table 4

Samples (stabilizer, enzyme protein : stabilizer (ratio by weight))	Residual activity(%)
Control	11
Sample 10 (A, 1 : 0.25 B, 1 : 0.25)	76
Sample 11 (A, 1 : 0.5 B, 1 : 0.5)	77

Example 5:

[0045] The control sample and Sample 6 prepared in Example 1 were coated as described below, and the stability, in a bleaching agent, of the enzyme contained in the resultant coated granules was assessed by measuring the percentage residual activity after storage at 40°C and a relative humidity of 80% for 14 days. The bleaching agent was the same as the model described in Example 1. The results are shown in Table 5.

(Coating method)

[0046] Using a mixing tumbling granulator, 66 parts by weight of each enzyme-containing granulated product was blended with 27 parts by weight of talc (mean particle size: 36 pm) and 7 parts by weight of polyethylene glycol (mean molecular weight: 6,000), all at once. Coated granules having a diameter ranging from 350 to 1,000 μm were obtained.

Table 5

Samples (stabilizer, enzyme protein : stabilizer (ratio by weight))	Residual activity(%)
Control (Coated with the control from Example 1)	0
Sample 12 (A, 1 : 5 B, 1 : 2.5) (Coated with Sample 6 from Example 1)	50

Example 6 (Formulation of a detergent)

[0047]

Ingredients	amounts (parts by weight)
Sodium linear (C_{12}-C_{13}) benzenesulfonate	10
Polyoxyethylene (EO=10) alkyl(C_{12}-C_{13}) ether	10
Zeolite	30
Sodium carbonate	10
Sodium perborate	25
Enzyme-containing granulated product prepared in Example 1	10
Water	15

[0048] As described above, the granulated product according to the present invention loses only a minimal level of enzyme activity even in the copresence of a bleaching agent, and exhibits excellent solubility. Therefore, bleach compositions and detergent compositions prepared by incorporating the granulated product fully exhibit the enzyme activity and bleaching activity.

Claims

1. An enzyme-containing granulated product comprising a uniformly dispersed state of an enzyme and two or more stabilizers characterized in that the stabilizers are a combination of a reducing agent and an antioxidant.
2. The enzyme-containing granulated product according to Claim 1, wherein the enzyme is a hydrolase.
3. The enzyme-containing granulated product according to Claim 1 or 2, wherein the stabilizers are sodium tetraborate and sodium erythorbate.
4. The enzyme-containing granulated product according to any one of Claims 1 to 3, wherein the stabilizers are incorporated at a concentration of 0.1 to 3,000% by weight calculated in relation to the mass of enzyme protein.
5. The enzyme-containing granulated product according to any one of Claims 1 to 4, further comprising a coating.
6. A method for the manufacture of the enzyme-containing granulated product as set forth in any one of Claims 1 to 5, comprising the steps of drying a solution containing said enzyme and said stabilizers and subjecting the dry material to granulation, and optionally, coating the surfaces of the resultant granules.
7. A method for the manufacture of the enzyme-containing granulated product as set forth in any one of Claims 1 to 5, comprising wet-granulating a solution containing said enzyme and said stabilizers, subsequently drying the granulated material, and optionally, coating the surface of the resultant dry granulated material with a coating agent.
8. A method for the manufacture of the enzyme-containing granulated product as set forth in any one of Claims 1 to 5, comprising uniformly mixing powder of said enzyme and powder of said stabilizers, subsequently granulating said mixture, and optionally, coating the surface of the resultant granules with a coating agent.
9. A bleaching composition comprising the enzyme-containing granulated product as described in any one of Claims 1 to 5, and a bleaching agent.
10. A detergent composition comprising the enzyme-containing granulated product as described in any one of Claims 1 to 5, a bleaching agent, and a surfactant.

Revendications

1. Produit granulé contenant une enzyme comprenant un état uniformément dispersé d'une enzyme et au moins

deux stabilisants, caractérisé en ce que les stabilisants sont une combinaison d'un agent réducteur et d'un antioxydant.

2. Produit granulé contenant une enzyme selon la revendication 1, dans lequel l'enzyme est une hydrolase.

3. Produit granulé contenant une enzyme selon la revendication 1 ou 2, dans lequel les stabilisants sont du tétraborate de sodium et de l'érythorbate de sodium.

4. Produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 3, dans lequel les stabilisants sont incorporés à une concentration de 0,1 à 3 000% en poids, calculée par rapport à la masse de la protéine enzymatique.

5. Produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 4, comprenant en outre un enrobage.

6. Procédé de fabrication du produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 5, comprenant les étapes consistant à faire sécher une solution contenant ladite enzyme et lesdits stabilisants et à soumettre la matière sèche à une granulation et, le cas échéant, à chauffer les surfaces des granulés résultants.

7. Procédé de fabrication du produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 5, comprenant les étapes consistant à granuler à l'état humide une solution contenant ladite enzyme et lesdits stabilisants, à sécher ensuite la matière granulée et, le cas échéant, à enrober la surface de la matière granulée sèche résultante avec un agent d'enrobage.

8. Procédé de fabrication du produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 5, comprenant les étapes consistant à mélanger uniformément de la poudre de ladite enzyme et de la poudre desdits stabilisants, puis à granuler ledit mélange et, le cas échéant, à enrober la surface des granulés résultants avec un agent d'enrobage.

9. Composition de blanchiment comprenant le produit granulé contenant une enzyme tel que décrit dans l'une quelconque des revendications 1 à 5, et un agent de blanchiment.

10. Composition détergente comprenant le produit granulé contenant une enzyme tel que décrit dans l'une quelconque des revendications 1 à 5, un agent de blanchiment et un tensioactif.

Patentansprüche

1. Enzym-enthaltendes granuliertes Produkt, umfassend einen gleichmäßig dispergierten Zustand eines Enzyms und zwei oder mehr Stabilisatoren, dadurch gekennzeichnet, daß die Stabilisatoren eine Kombination eines Reduktionsmittels und eines Antioxidationsmittels sind.

2. Enzym-enthaltendes granuliertes Produkt nach Anspruch 1, wobei das Enzym eine Hydrolase ist.

3. Enzym-enthaltendes granuliertes Produkt nach Anspruch 1 oder 2, wobei die Stabilisatoren Natriumtetraborat und Natriumerythorbat sind.

4. Enzym-enthaltendes granuliertes Produkt nach einem der Ansprüche 1 bis 3, wobei die Stabilisatoren in einer Konzentration von 0,1 bis 3.000 Gewichtsprozent, berechnet in Bezug auf die Masse des Enzymproteins, eingebracht werden.

5. Enzym-enthaltendes granuliertes Produkt nach einem der Ansprüche 1 bis 4, das ferner einen Überzug umfaßt.

6. Verfahren zur Herstellung des Enzym-enthaltenden granulierten Produkts nach einem der Ansprüche 1 bis 5, umfassend das Trocknen einer Lösung, die das Enzym und die Stabilisatoren enthält, und das Granulieren des trokkenen Materials und gegebenenfalls Überziehen der Oberflächen der erhaltenen Granulate.

7. Verfahren zur Herstellung des Enzym-enthaltenden granulierten Produkts nach einem der Ansprüche 1 bis 5,

umfassend das Feuchtgranulieren einer Lösung, die das Enzym und die Stabilisatoren enthält, das nachfolgende Trocknen des granulierten Materials und gegebenenfalls das Überziehen der Oberfläche des erhaltenen trockenen granulierten Materials mit einem Beschichtungsmittel.

8. Verfahren zur Herstellung des Enzym-enthaltenden granulierten Produkts nach einem der Ansprüche 1 bis 5, umfassend das gleichmäßige Mischen von Pulver des Enzyms und Pulver der Stabilisatoren, das anschließende Granulieren des Gemisches und gegebenenfalls das Überziehen der Oberfläche der erhaltenen Granulate mit einem Beschichtungsmittel.

9. Bleichmittelzusammensetzung, umfassend das Enzym-enthaltende granulierte Produkt gemäß der Beschreibung in einem der Ansprüche 1 bis 5 und ein Bleichmittel.

10. Detergenzzusammensetzung, umfassend das Enzym-enthaltende granulierte Produkt gemäß der Beschreibung in einem der Ansprüche 1 bis 5, ein Bleichmittel und ein grenzflächenaktives Mittel.

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Enzym enthaltendes Granulat, Herstellungsmethode und das Granulat enthaltende Zusammensetzungen

Produit granulé contenant une enzyme, méthodes pour sa préparation et compositions contenant le granulat

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Description

[0001] The present invention relates to an enzyme-containing granulated product having improved stability, and more particularly to an enzyme-containing granulated product that undergoes only minimal reduction in activity even in the presence of peroxides typified by bleaching agents. The invention also relates to methods for preparing such products as well as to bleach compositions and detergent compositions containing the product.

[0002] Detergents and bleaches for clothing frequently contain a variety of enzymes, in addition to surfactants or bleaching ingredients, in an effort to improve detergent power. These enzymes are usually incorporated in the form of granules so as not to lose their activity during storage and to sufficiently exhibit their activities during washing. The enzymatic stability of such enzyme-containing granulated products decreases when the granulated products are blended with bleaching agents, surfactants, builders for detergents, or similar materials. In particular, it is known that enzyme activity decreases considerably when a granulated product is blended with a bleaching agent.

[0003] Measures to prevent the reduction of enzyme activity of enzyme-containing granulated products are disclosed by Japanese Patent Application Laid-Open (*kokai*) No. 62-79298, which describes an enzyme composition in which the core part containing an enzyme is coated with a protective layer containing an alkaline buffering salt of pH 7-11, and by Japanese Patent Application Laid-Open (*kokai*) No. 3-149298, which describes a bleaching agent containing hydrase particles, in which the enzyme nuclei are coated with a protective agent such as a water-soluble alkali metal silicate, a transition metal, or a reducing agent.

[0004] However, those conventional methods for stabilizing enzymes have a problem in that when the thickness of the coating layer is increased or a large amount of a water-soluble substance is incorporated into the coatings so as to fully stabilize the enzymes, the enzyme-containing granulated products come to have reduced solubility in water, and therefore the detergent power of enzymes cannot be sufficiently exerted during use in washing. On the other hand, when the thickness of the coating layer is reduced for the purpose of solubility, the enzymes cannot be satisfactorily stabilized.

[0005] Under the above circumstances, the present inventors conducted a variety of studies regarding means for stabilizing enzymes, and found that, as far as enzymes, such as hydrolase, are concerned, the copresence, in a uniformly dispersed state, of such an enzyme, and a stabilizing agent, such as a reducing agent and an antioxidant, is effective in avoiding deactivation of the enzyme and provides a granulated product having excellent solubility. This is surprising because in the past, it has been customary in the preparation of such a granulated product to separate an enzyme from a reducing agent by the use of a coating. The present invention was accomplished based on this finding.

[0006] EP-A-0 206 418 discloses a method for stabilizing enzymes without using the coating procedure. In particular, EP-A-0 206 418 refers to a storage stable granular composition comprising a homogeneously mixed granulate of enzymes and alkaline buffer salt to protect enzymes from deactivation when mixed with a strong peroxyacid bleach granulate. Also a method for preparing said composition is disclosed whereby the constituents are granulated as wet powder mixtures and subsequently dried.

[0007] Accordingly, the present invention provides an enzyme-containing granulated product comprising an enzyme and two or more stabilizers characterized in that the stabilizers are a combination of a reducing agent and an antioxidant wherein said reducing agent is selected from the group consisting of: alkali metal salts and alkaline earth metal salts of boric acid, sulfurous acid or thiosulfuric acid and wherein said antioxidant is selected from the group consisting of: ascorbic acid, sodium ascorbate, erythorbic acid, sodium erythorbate, dl-α-tocopherol, isopropyl citrate, butylated hydroxytoluene (BTH), butylated hydroxyanisol (BHA) and tannic acid; and a method for preparing such a product.

[0008] The present invention also provides a bleach composition comprising the enzyme-containing granulated product and a bleaching agent.

[0009] The present invention also provides a detergent composition comprising the enzyme-containing granulated product and a surfactant.

[0010] The enzyme-containing granulated product of the present invention comprises, in a uniformly dispersed state, an enzyme, and two or more stabilizers which are a combination of reducing agents and antioxidants as defined above. As used herein, the expression "in a uniformly dispersed state" refers to a state in which an enzyme and stabilizer are not segregated in separate layers, and therefore, an enzyme and a stabilizer are not necessarily in a dispersed state on the molecular level and they may be present as a dispersed powder.

[0011] Enzymes which are used in the present invention are not particularly limited as long as they can be incorporated into bleaching agents or detergents. Preferably, hydrolases are used, and specifically, proteases, esterases, and carbohydrases are used.

[0012] Specific examples of proteases include pepsin, trypsin, chymotrypsin, collagenase, keratinase, elastase, subtilisin, papain, aminopeptidase, and carboxypeptidase.

[0013] Specific examples of esterases include gastric lipase, pancreatic lipase, lipases of vegetable origin, phospholipases, choline esterases, and phosphatases.

[0014] Specific examples of carbohydrases include cellulase, maltase, saccharase, amylase, pectitase, and α- and

β-glycosidases.

[0015] The stabilizer used in the present invention is a mixture of two or more of reducing agents and antioxidants.

[0016] The reducing agents are selected from the group consisting of alkali metal salts (such as sodium salts and potassium salts) and alkaline earth metal salts (such as calcium salts and magnesium salts) of boric acid, sulfurous acid, thiosulfuric acid. Specifically, sodium tetraborate, sodium sulfite, and sodium thiosulfate are used. The antioxidants are selected from the group consisting of ascorbic acid, sodium ascorbate, erythorbic acid, sodium erythorbate, dl-α-tocopherol, isopropyl citrate, butylated hydroxytoluene (BHT), butylated hydroxyanisol (BHA) and tannic acid. Of these a combination of sodium tetraborate and sodium erythorbate is particularly preferred.

[0017] The enzymes and stabilizers may be used singly or in combinations of two or more. The amount of enzymes contained in the granulated product is not particularly limited. In consideration of the effect desired when the enzymes are incorporated into detergents or bleaching agents, it is generally preferred that the amount of the enzymes is between 0.01 and 50% by weight, and more preferably between 0.1 and 30% by weight. The amount of stabilizers varies depending on the types of enzymes employed. It is preferred that the stabilizers are incorporated at a concentration between 0.1 and 3,000% by weight, more preferably between 1 and 500% by weight, and particularly preferably between 10 and 300% by weight, calculated in relation to the amounts of enzyme protein. The ratio (by weight) of the reducing agent to the antioxidant which are to be incorporated is between 1/9 and 9/1, preferably between 1/3 and 3/1, and particularly preferably between 1/3 and 1/1.

[0018] The granulated product of the present invention may contain further additives, in addition to the above-mentioned components, which are needed for granulation. Such additives include binders, particularly water-soluble organic binders. The following may be cited as examples of water-soluble organic binders that can be used together with the mentioned essential components of the present invention: (a) water-soluble polymers selected from the group consisting of polyethylene glycol having a melting point of not lower than 35°C, derivatives thereof, and polyoxyethylene polyoxypropylene copolymers; (b) nonionic surfactants having a melting point or pour point of not lower than 35°C; and (c) polycarboxylates having a mean molecular weight of not less than 4,000. These may be used singly, or in combinations of two or more.

[0019] Specific examples of particularly preferred water-soluble organic binders include, among the class of polyethylene glycol and its derivatives (a), polyethylene glycol, polyethylene glycol sulfate, and methoxypolyethylene glycol; among the class of nonionic surfactants (b), polyoxyethylene alkyl ethers; and among the class of polycarboxylates (c), alkali metal salts of polyacrylic acid, acrylic acid/maleic acid copolymers, and polyacetal carboxylate.

[0020] These water-soluble organic binders are advantageous, since they are components which are also used in detergent compositions. The amount of usually employed water-soluble organic binders is not univocally determined, as their properties vary from binder to binder. However, under general circumstances, those which exhibit binding power at a minimum concentration are usually preferred as they provide room for maximizing the enzyme activity of the resultant enzyme-containing granulated products. From this point, these water-soluble organic binders are usually incorporated in an enzyme-containing granulated product at a concentration of 5 to 50% by weight, and preferably 10 to 30% by weight.

[0021] According to the present invention, powdery bulking agents may also be added if needed. Exemplary bulking agents include one or more inorganic salts selected from the group consisting of sulfates, carbonates, and hydrochlorides of alkali metals or alkaline earth metals. Of these, water-soluble inorganic alkali metal salts such as sodium sulfate, sodium carbonate, and sodium chloride are particularly preferred in view that they do not adversely affect detergent power. Other useful bulking agents include water-soluble organic salts such as sodium citrate, talc, titanium oxide, calcium carbonate, zeolite, magnesium carbonate, activated clay, and kaolin.

[0022] The granulated product of the present invention may also contain a variety of inorganic salts such as calcium salts and magnesium salts; as well as organic materials including surfactants, saccharides, and carboxymethylcellulose. Moreover, if synthesized hectorite or sepiolite is incorporated, odoriferous components derived from cultivation can be adsorbed. The enzyme-containing granules may be colored by incorporating thereto colorants or dyes.

[0023] The method for the manufacture of the granulated product of the present invention is not particularly limited so long as it is capable of incorporating an enzyme and a stabilizer in a uniformly dispersed state. For example, any of the following methods may be used: (1) a solution containing an enzyme and a stabilizer is dried, followed by granulation; (2) a solution containing an enzyme and a stabilizer is subjected to a wet granulation process and subsequently the granulated material is dried; and (3) an enzyme powder and a stabilizer powder are uniformly blended, followed by granulation. Of these, method (1) is particularly preferred.

[0024] In method (1) above, the solution containing an enzyme and a stabilizer is preferably an aqueous solution, and more preferably an aqueous solution containing a buffer agent. The solution may be dried via spray-drying, or freeze-drying, with spray-drying being particularly preferred. Means for granulating the resultant dry powder are not particularly limited, and wet granulation and dry granulation are both preferable. Illustrative granulation methods include extruding, tumbling, fluidized-bed granulation, spray granulation, and disintegration granulation. Among them, tumbling granulation, particularly tumbling granulation with agitating blades, is preferred. Examples of mixing tumbling granu-

lation machines are a Henschel mixer (Mitsui-Miike Kakoki K.K.), a high-speed mixer (Fukae Kogyo K.K.), and a vertical granulator (Fuji Sangyo K.K.). These three share a common feature of having a vertical agitator axis with a mixing blade inside a mixing tank of a vertical type. A granulator having a horizontal agitator axis, a Loedige mixer (Loedige Co.), may also be used.

[0025] When method (2) is used, a solution containing an enzyme and a stabilizer can be prepared in a manner similar to that of method (1).

[0026] In method (3), dry-format granulation is performed.

[0027] The particle size of the thus-obtained granulated product is not particularly limited. The mean particle size is generally between 200 and 3,000 μm, and preferably between 350 and 1,500 μm.

[0028] The enzyme-containing granulated product of the present invention preferably has a coating thereon so as to obtain even further improved stability, though the product may be used without coating.

[0029] Materials used for coating the enzyme-containing granulated product of the present invention are not particularly limited. They may be water-soluble film-forming polymers such as polyethylene glycol, polyacrylate, polyvinyl alcohol, polyvinyl pyrrolidone, cellulose derivatives, and starch derivatives; combinations of these polymers and water-soluble or slightly-soluble inorganic particles such as talc, clay, titanium oxide, calcium carbonate; or combinations of the polymers and protective agents such as alkali metal silicate and alkali metal carbonates.

[0030] Coating materials are preferably used in a ratio by weight of 0.1 to 0.7, particularly preferably 0.2 to 0.6, when the amount of the enzyme-containing granulated product is taken as 1.

[0031] The enzyme-containing granulated product of the present invention may be coated through a conventional method using a fluidized bed granulator, a granulator equipped with a coating pan, or a mixing granulator.

[0032] Since the granulated product of the present invention is very stable against a variety of peroxides which are used as bleaching agents, when the granulated product and a bleaching agent are blended it is possible to obtain a bleaching agent exhibiting stable enzyme activity and providing an excellent bleaching effect. Examples of useful bleaching agents include sodium percarbonate, sodium perborate, sodium hypochlorite, and dichloroisocyanic acid. They are usually incorporated in bleaching compositions at a concentration of 10 to 95%, and preferably 50 to 80%.

[0033] The granulated product of the present invention maintains excellent enzyme stability even when it is formed into a detergent composition containing a bleaching agent and a surfactant. Bleaching agents which are useful in this case are the same as those listed above. The amount of bleaching agents is 0.5-45% by weight, and particularly preferably 1-20% by weight.

[0034] The amount of the enzyme-containing granulated product to be incorporated into a detergent composition varies depending on the specific activity in the enzyme powder, type of the enzyme, and the content of the enzyme in the granulated product. It is preferably between 0.001 and 70% by weight, and particularly between 0.1 and 10% by weight.

[0035] The following may be mentioned as examples of surfactants which are used in the present invention: anionic surfactants, e.g., alkylbenzene sulfonates, alkyl or alkenyl ether sulfates, alkyl or alkenyl sulfates, olefin sulfonates, alkane sulfonates, saturated or unsaturated fatty acid salts, alkyl or alkenyl ether carboxylates, α-sulfofatty acid salts or esters, amino acid-type surfactants, N-acylamino acid-type surfactants, alkyl or alkenyl acid phosphates, alkyl or alkenyl phosphates, and their salts; amphoteric surfactants, e.g., carboxy or sulfobetaine-type surfactants; nonionic surfactants, e.g., polyoxyalkylene alkyl or alkenyl ethers, polyoxyethylene alkylphenyl ethers, higher fatty acid alkanolamides and their alkylene oxide adducts, sucrose fatty acid esters, fatty acid glycerol monoesters, alkyl amine oxides, and alkyl glycosides; and cationic surfactants, e.g., quaternary ammonium salts. These surfactants are preferably incorporated in the detergent composition of the present invention at a concentration of 10-90% by weight, and particularly preferably 10-50% by weight.

[0036] Preferably, the detergent composition of the present invention contains inorganic electrolytes and chelating agents. Examples of inorganic electrolytes include carbonates, hydrogen carbonates, silicates, borates, and alkanolamines and sulfates. They are usually incorporated in amounts between 0 and 90% by weight, and preferably between 1 and 40% by weight.

[0037] Examples of chelating agents include phosphates such as tripolyphosphates, pyrophosphates, and orthophosphates; salts of phosphonic acid such as ethane-1,1-diphosphonic acid; salts of phosphonocarboxylic acid such as 2-phosphonobutane-1,2-dicarboxylic acid; salts of amino acids such as aspartic acid and glutamic acid; aminopolyacetates such as nitrilotriacetate and ethylenediaminetetraacetate; polymer chelating agents such as polyacrylic acid and polyaconitic acid; salts of organic acids such as oxalic acid and citric acids; and aluminosilicates. These chelating agents are usually incorporated in a detergent composition at a concentration of between 0 and 50% by weight, with between 1 and 30% by weight being more preferred.

[0038] Optional ingredients may be incorporated as desired in small amounts. Such optional ingredients include antiredeposition agents, e.g., polyethylene glycol and carboxymethylcellulose; fluorescent dyes; bluing agents; colorants; caking preventive agents; solubilizers; enzymes or activators for bleaching agents; and metal corrosion inhibitors.

[0039] The detergent composition of the present invention can be prepared by blending the above-mentioned ingre-

dients to thereby form a granular detergent composition for clothing, dishes, and for house cleaning, according to conventional methods.

Examples

[0040] The present invention is further illustrated by the following Examples, which should not construed as limiting the invention.

Example 1:

[0041]

(1) An aqueous solution containing a crude enzyme having an amylase activity (derived from *Bacillus* sp. KSM-AP1378 (FERM BP-3048) was used as an aqueous enzyme solution (concentration of enzyme protein: 0.3% by weight). To this solution, sodium tetraborate (indicated as A in Table 1) and sodium erythorbate (indicated as B in Table 1) were added as stabilizers so that the amount of the stabilizers became 1-10 times that of the mass of the enzyme protein in the aqueous solution (on a weight basis). The thus-prepared mixtures were used as samples.
(2) A control sample (which did not contain a stabilizer) and the sample prepared in (1) were spray-dried by the application of 150°C air produced by an atomizer-type spray drier (temperature of exhaust air: 75°C), thereby obtaining a solid granular enzyme preparation.
(3) The stability of the enzyme in a bleaching agent was assessed by measuring the percentage residual activity after storage at 40°C and a relative humidity of 80% for 3 days. As a model bleaching agent, a composition including 85% by weight of sodium percarbonate, 3% by weight of linear alkyl(C_{12}-C_{13})benzenesulfonate, and 12% by weight of sodium carbonatewas used. This bleaching composition was blended with the solid granularenzyme preparation at a ratio of 5:1 (by weight) and the resultant mixture was stored under the above-mentioned conditions. The results are shown in Table 1.

Table 1

Samples (stabilizer, enzyme protein : stabilizer (ratio by weight))	Residual activity(%)
Control	5
Sample 1 (A, 1 : 1.5)*	10
Sample 2 (A, 1 : 5)*	25
Sample 3 (A, 1 : 10)*	30
Sample 4 (B, 1 : 2.5)*	20
Sample 5 (B, 1 : 5)*	25
Sample 6 (A, 1 : 5 B, 1 : 2.5)	57
Sample 7 (A, 1 : 10 B, 1 : 2.5)	74

* Not in accordance with the invention.

Example 2:

[0042] An enzyme-containing granulated product prepared in Example 1 and, for comparison, a granulated product coated by the addition of a stabilizer during the step of granulation were incorporated into a bleaching agent. The general procedure of Example 1 was repeated, and the stability of the enzyme was assessed by measuring the percentage residual activity after storage at 40°C and a relative humidity of 80% for 5 days. The results are shown in Table 2. In Table 2, Comparative Sample 1 was prepared by coating a granulated product which was identical to the control product using a stabilizer in the amount same as that employed in the preparation of Sample 7. Sample 7 was the same as that used in Example 1.

Table 2

Samples	Residual activity (%)
Control (without a stabilizer)	5

Table 2 (continued)

Samples	Residual activity (%)
Comparative Sample 1 (coated with a stabilizer)	6
Sample 7 (same as that used in Example 1)	80

Example 3:

[0043] An aqueous solution of a crude enzyme having cellulase activity (derived from *Bacillus* sp. KSM635-KNV (FERM P-13549)) was used as an aqueous enzyme solution (concentration of enzyme protein: 2.5% by weight). To this solution, sodium tetraborate (indicated as A in Table 3) and sodium erythorbate (indicated as B in Table 3) were added as stabilizers so that the amount of the stabilizers became 1-2 times that of the mass of the enzyme protein in the aqueous solution (on a weight basis). The thus-prepared mixtures were used as samples. Subsequently, a similar procedure as described in Example 1 was performed.

Table 3

Samples (stabilizer, enzyme protein : stabilizer (ratio by weight))	Residual activity(%)
Control	16
Sample 8 (A, 1 : 1 B, 1 : 1)	91
Sample 9 (A, 1 : 2 B, 1 : 2)	98

Example 4:

[0044] An aqueous solution of a crude enzyme having protease activity (derived from *Bacillus* sp. KSM-K16 (FERM P-3367)) was used as an aqueous enzyme solution (concentration of enzyme protein: 7.5% by weight). To this solution, sodium tetraborate (indicated as A in Table 4) and sodium erythorbate (indicated as B in Table 4) were added as stabilizers so that the amount of the stabilizers became 0.25 to 0.5 times that of the mass of the enzyme protein in the aqueous solution (on a weight basis). The thus-prepared mixtures were used as samples. Subsequently, a similar procedure as described in Example 1 was performed.

Table 4

Samples (stabilizer, enzyme protein : stabilizer (ratio by weight))	Residual activity(%)
Control	11
Sample 10 (A, 1 : 0.25 B, 1 : 0.25)	76
Sample 11 (A, 1 : 0.5 B, 1 : 0.5)	77

Example 5:

[0045] The control sample and Sample 6 prepared in Example 1 were coated as described below, and the stability, in a bleaching agent, of the enzyme contained in the resultant coated granules was assessed by measuring the percentage residual activity after storage at 40°C and a relative humidity of 80% for 14 days. The bleaching agent was the same as the model described in Example 1. The results are shown in Table 5.

(Coating method)

[0046] Using a mixing tumbling granulator, 66 parts by weight of each enzyme-containing granulated product was blended with 27 parts by weight of talc (mean particle size: 36 pm) and 7 parts by weight of polyethylene glycol (mean molecular weight: 6,000), all at once. Coated granules having a diameter ranging from 350 to 1,000 μm were obtained.

Table 5

Samples (stabilizer, enzyme protein : stabilizer (ratio by weight))	Residual activity(%)
Control (Coated with the control from Example 1)	0
Sample 12 (A, 1 : 5 B, 1 : 2.5) (Coated with Sample 6 from Example 1)	50

Example 6 (Formulation of a detergent)

[0047]

Ingredients	amounts (parts by weight)
Sodium linear (C_{12} -C_{13}) benzenesulfonate	10
Polyoxyethylene (EO=10) alkyl(C_{12} -C_{13}) ether	10
Zeolite	30
Sodium carbonate	10
Sodium perborate	25
Enzyme-containing granulated product prepared in Example 1	10
Water	15

[0048] As described above, the granulated product according to the present invention loses only a minimal level of enzyme activity even in the copresence of a bleaching agent, and exhibits excellent solubility. Therefore, bleach compositions and detergent compositions prepared by incorporating the granulated product fully exhibit the enzyme activity and bleaching activity.

Claims

1. An enzyme-containing granulated product comprising a uniformly dispersed state of an enzyme and two or more stabilizers **characterized in that** the stabilizers are a combination of a reducing agent and an antioxidant, wherein said reducing agent is selected from the groups consisting of: alkali metal salts and alkaline earth metal salts of boric acid, sulfurous acid or thiosulfuric acid and wherein said antioxidant is selected from the group consisting of: ascorbic acid, sodium ascorbate, erythorbic acid, sodium erythorbate, dl-α-tocopherol, isopropyl citrate, butylated hydroxytoluene (BHT), butylated hydroxyanisol (BHA) and tannic acid.

2. The enzyme-containing granulated product according to Claim 1, wherein the enzyme is a hydrolase.

3. The enzyme-containing granulated product according to Claim 1 or 2, wherein the stabilizers are sodium tetraborate and sodium erythorbate.

4. The enzyme-containing granulated product according to any one of Claims 1 to 3, wherein the stabilizers are incorporated at a concentration of 0.1 to 3,000% by weight calculated in relation to the mass of enzyme protein.

5. The enzyme-containing granulated product according to any one of Claims 1 to 4, further comprising a coating.

6. A method for the manufacture of the enzyme-containing granulated product as set forth in any one of Claims 1 to 5, comprising the steps of drying a solution containing said enzyme and said stabilizers and subjecting the dry material to granulation, and optionally, coating the surfaces of the resultant granules.

7. A method for the manufacture of the enzyme-containing granulated product as set forth in any one of Claims 1 to 5, comprising wet-granulating a solution containing said enzyme and said stabilizers, subsequently drying the granulated material, and optionally, coating the surface of the resultant dry granulated material with a coating agent.

8. A method for the manufacture of the enzyme-containing granulated product as set forth in any one of Claims 1 to 5, comprising uniformly mixing powder of said enzyme and powder of said stabilizers, subsequently granulating said mixture, and optionally, coating the surface of the resultant granules with a coating agent.

9. A bleaching composition comprising the enzyme-containing granulated product as described in any one of Claims 1 to 5, and a bleaching agent.

10. A detergent composition comprising the enzyme-containing granulated product as described in any one of Claims 1 to 5, a bleaching agent, and a surfactant.

Patentansprüche

1. Enzym-enthaltendes granuliertes Produkt, umfassend einen gleichmäßig dispergierten Zustand eines Enzyms und zwei oder mehr Stabilisatoren, **dadurch gekennzeichnet, dass** die Stabilisatoren eine Kombination eines Reduktionsmittels und eines Antioxidationsmittels sind, wobei das Reduktionsmittel ausgewählt ist aus der Gruppe bestehend aus: Alkalimetallsalzen und Erdalkalimetallsalze der Borsäure, Schwefelsäure oder Thioschwefelsäure, und wobei das Antioxidationsmittel ausgewählt ist aus der Gruppe bestehend aus: Ascorbinsäure, Natriumascorbat, Erythorbinsäure, Natriumerythorbat, dl-α-Tocopherol, Isopropylcitrat, Butylhydroxytoluol (BHT), Butylhydroxyanisol (BHA) und Tannin.

2. Enzym-enthaltendes granuliertes Produkt nach Anspruch 1, wobei das Enzym eine Hydrolase ist.

3. Enzym-enthaltendes granuliertes Produkt nach Anspruch 1 oder 2, wobei die Stabilisatoren Natriumetraborat und Natriumerythorbat sind.

4. Enzym-enthaltendes granuliertes Produkt nach einem der Ansprüche 1 bis 3, wobei die Stabilisatoren in einer Konzentration von 0,1 bis 3000 Gewichtsprozent, berechnet in Bezug auf die Masse des Enzymproteins, eingebracht werden.

5. Enzym-enthaltendes granuliertes Produkt nach einem der Ansprüche 1 bis 4, das ferner einen Überzug umfasst.

6. Verfahren zur Herstellung des Enzym-enthaltenden granulierten Produkts nach einem der Ansprüche 1 bis 5, umfassend das Trocknen einer Lösung, die das Enzym und die Stabilisatoren enthält, und das Granulieren des trockenen Materials und gegebenenfalls Überziehen der Oberflächen der erhaltenen Granulate.

7. Verfahren zur Herstellung des Enzym-enthaltenden granulierten Produkts nach einem der Ansprüche 1 bis 5, umfassend das Feuchtgranulieren einer Lösung, die das Enzym und die Stabilisatoren enthält, das nachfolgende Trocknen des granulierten Materials und gegebenenfalls das Überziehen der Oberfläche des erhaltenen trockenen granulierten Materials mit einem Beschichtungsmittel.

8. Verfahren zur Herstellung des Enzym-enthaltenden granulierten Produkts nach einem der Ansprüche 1 bis 5, umfassend das gleichmäßige Mischen von Pulver des Enzyms und Pulver der Stabilisatoren, das anschließende Granulieren des Gemisches und gegebenenfalls das Überziehen der Oberfläche der erhaltenen Granulate mit einem Beschichtungsmittel.

9. Bleichmittelzusammensetzung, umfassend das Enzym-enthaltende granulierte Produkt gemäß der Beschreibung in einem der Ansprüche 1 bis 5 und ein Bleichmittel.

10. Detergenzzusammensetzung, umfassend das Enzym-enthaltende granulierte Produkt gemäß der Beschreibung in einem der Ansprüche 1 bis 5, ein Bleichmittel und ein grenzflächenaktives Mittel.

Revendications

1. Produit granulé contenant une enzyme comprenant un état uniformément dispersé d'une enzyme et au moins deux stabilisants, **caractérisé en ce que** les stabilisants sont une combinaison d'un agent réducteur et d'un antioxydant, dans lequel ledit agent réducteur est choisi dans le groupe constitué par les sels de métaux alcalins et les sels de métaux alcalino-terreux d'acide borique, d'acide sulfureux ou d'acide thiosulfnrique, et dans lequel ledit antioxydant est choisi dans le groupe constitué par l'acide ascorbique, l'ascorbate de sodium, l'acide érythorbique, l'érythorbate de sodium, le dl-α-tocophérol, le citrate d'isopropyle, l'hydroxytoluène butylé (BHT), l'hydroxyanisole butylé (BHA) et l'acide tannique.

2. Produit granulé contenant une enzyme selon la revendication 1, dans lequel l'enzyme est une hydrolase.

3. Produit granulé contenant une enzyme selon la revendication 1 ou 2, dans lequel les stabilisants sont du tétraborate de sodium et de l'érythorbate de sodium.

4. Produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 3, dans lequel les stabilisants

sont incorporés à une concentration de 0,1 à 3 000% en poids, calculée par rapport à la masse de la protéine enzymatique.

5. Produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 4, comprenant en outre un enrobage.

6. Procédé de fabrication du produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 5, comprenant les étapes consistant à faire sécher une solution contenant ladite enzyme et lesdits stabilisants et à soumettre la matière sèche à une granulation et, le cas échéant, à chauffer les surfaces des granulés résultants.

7. Procédé de fabrication du produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 5, comprenant les étapes consistant à granuler à l'état humide une solution contenant ladite enzyme et lesdits stabilisants, à sécher ensuite la matière granulée et, le cas échéant, à enrober la surface de la matière granulée sèche résultante avec un agent d'enrobage.

8. Procédé de fabrication du produit granulé contenant une enzyme selon l'une quelconque des revendications 1 à 5, comprenant les étapes consistant à mélanger uniformément de la poudre de ladite enzyme et de la poudre desdits stabilisants, puis à granuler ledit mélange et, le cas échéant, à enrober la surface des granulés résultants avec un agent d'enrobage.

9. Composition de blanchiment comprenant le produit granulé contenant une enzyme tel que décrit dans l'une quelconque des revendications 1 à 5, et un agent de blanchiment.

10. Composition détergente comprenant le produit granulé contenant une enzyme tel que décrit dans l'une quelconque des revendications 1 à 5, un agent de blanchiment et un tensioactif.